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COMPLETE SPECIFICATION

(54) APPARATUS FOR DIGGING A TRENCH

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Price 12½p

The invention relates to an apparatus for digging a trench and in particular to apparatus including a digging chain guided around sprocket wheels mounted on both ends of a digging bar, which is carried by a vehicle, the depth of the lower end of the digging bar being adjustable by a hydraulically actuable piston cylinder unit, and the apparatus having means for feeding from the vehicle at the level of the free end of the digging bar a flexible pipe to be laid on the bottom of the trench to be dug.

The prior art vehicles of the kind specified are capable of digging trenches only about 2 metres in depth. The digging bar is attached to the vehicle with provision for pivoting in a vertical plane. As the vehicle travels, the end of the digging bar slowly digs down to the required depth.

One considerable disadvantage of the prior art vehicles is that in practice they can travel only in a straight line, so that the trench to be dug must be always straight. Embodiments of the present invention provide apparatus which can also describe curves during digging.

Thus, according to the present invention the digging bar is connected to the vehicle via a hinge having an axis perpendicular to the base of the vehicle. In a construction of the kind specified the vehicle can therefore pivot in a horizontal plane in relation to the digging bar.

According to one embodiment of the invention, the digging bar is supported by a lifting system which makes the lower end of the digging bar perform a substantially rectilinear lifting movement in the bar's own direction, and the means for feeding the flexible pipe are formed by a guide pipe which extends close behind the digging bar parallel therewith, is rigidly connected to the digging bar and has at its bottom end a mouth-piece directed away from the digging chain. With a vehicle constructed in the way specified, a very deep trench can be dug, the digging bar being introduced into the soil substantially rectilinearly while the vehicle is stationary or needs to be moved over only a very short distance. Since the digging bar moves substantially rectilinearly in the bar's own direction, the horizontal distance over which the digging bar is disposed in the trench is substantially identical for all digging depths. Thus the bar will not be twisted as a curve is formed in the line of the trench. Due to the guide pipe being disposed collapsing trench wall does not hold the digging bar or the guide sheath fast, the returning part of the digging chain being moreover protected thereby against an excessive feed of collapsing soil.

In a convenient embodiment of the apparatus according to the invention the digging bar has at least two beams which are disposed transversely of the plane of the digging chain, are spaced out from one another in the direction of the digging bar and are each connected at their ends via rods and ball and socket joints to the ends of one of two beams attached vertically spaced out from one another to a sleeve which can rotate around a pivot attached to the vehicle perpendicularly to the

base thereof, and at least two of the rods having ball and socket joints are rigidly interconnected via two transverse bars interconnected via at least one torsion bar rigidly attached to each of the transverse bars. In an embodiment of the kind specified, the digging bar can also rotate in relation to the vehicle around a pivot extending in the longitudinal direction thereof. Due to the transverse rods with the torsion bar, the freedom of the digging bar to rotate around this axis is limited, so that an adequate straightening force continues to be exerted on the digging bar. The vehicle can therefore drive over uneven ground, while the digging bar can remain in the vertical digging plane. Since the straightening force is maintained, there is no risk that the digging bar will be deflected from the vertical as the vehicle travels over flat ground.

In a convenient embodiment of the invention the hydraulic apparatus for adjusting the digging depth is hingeably connected by one end to the rotary sleeve and is hingedly connected by the other end to one of the transverse bars.

According to one feature of the invention the vertical pivot is attached to the vehicle via a hinge having a horizontal pivot perpendicular to the longitudinal axis of the vehicle, and a second hydraulic adjusting apparatus is hingeably connected by one end to a fixed member of the vehicle and is hingeably connected by the other end to the vertical pivot. As a result, when the digging bar is so far displaced in its own direction to be in its highest position, the second hydraulic adjusting apparatus can be used to tilt the pivot and therefore the digging bar connected thereto

via the supporting apparatus. The digging bar can therefore be put in the transportation position in a very simple manner, and the vehicle can be driven along the roads.

In a convenient embodiment of the invention, that portion of the vertical pivot with which the hydraulic adjusting apparatus engages extends through a groove extending peripherally in the sleeve. With an embodiment of this kind, therefore, the sleeve can pivot around the vertical pivot without being impeded by the attachment for the hydraulic adjusting apparatus.

An embodiment of the invention will now be described in greater detail in the following description with reference to the accompanying drawings, wherein:

Fig. 1 is a side elevation of an apparatus embodying the invention in the operative position;

Fig 2 is a rear elevation of the apparatus shown in Fig. 1, and

Fig. 3 is a plan view of the apparatus shown in Fig. 1, illustrated describing a curve.

A vehicle 1 has endless tracks 2, 3 and a driving apparatus 4. Adjacent its rear end, the vehicle has a pivot 5 which is vertical in the normal operating

position and is attached to the frame of the vehicle 1 via a hinge 6 whose axis extends transversely of the vehicle. The pivot 5 has a forwardly directed arm 7 with which a piston rod 8 of a hydraulic adjusting apparatus engages. Cylinder 9 of the hydraulic adjusting apparatus is hingeably attached by its end to the frame of the vehicle 1. The hydraulic adjusting apparatus 8, 9 can be used to alter the position of the pivot 5, as will be described in greater detail hereinafter.

Disposed around the pivot 5 is a sleeve 10 formed with a peripherally extending groove 11 through which the arm 7 extends. The sleeve 10 has two beams 12, 13 extending horizontally on either side at some distance from one another and rigidly attached to the sleeve 10. Rods 14, 16; 15, 17 are attached by ball and socket joints to the ends of beams 12 and 13 respectively. The rods 14, 16; 15, 17 are attached at the other end by ball and socket joints to a rigid rectangular framework 18 rigidly attached to a digging bar 19, in which sprocket wheels 20, 21 are disposed adjacent its ends, a digging chain 22 running round the sprocket wheels 20, 21. The digging chain can be driven from the vehicle in a manner not shown in detail. A guide sheath or pipe 25 is attached close behind the digging chain 22 and parallel therewith via the agency of supports 23, 24. The guide sheath or pipe 25 is used for feeding a flexible pipe 26 to be laid on the bottom 27 of a trench to be dug by means of the digging chain 22. To this end the guide sheath 25 has a mouthpiece 28 extending away from the digging chain 22 substantially parallel with the bottom 27 of the trench. Extending between the top

two rods 14, 15 are two transverse bars 29, 30 which are attached thereto. The transverse bars 29, 30 are interconnected via two torsion bars 31, 32 rigidly attached to the transverse bars. Piston rod 33 of a hydraulic adjusting apparatus is hingeably attached to the bar 29, while the end of the cylinder 34 is hingeably attached to a member 35 which is rigidly attached to the sleeve 10. The hydraulic adjusting apparatus 34, 33 can act on the transverse bar 29 and the rods 14, 15 to adjust the framework 18 and therefore the digging bar 19 in the upward direction.

In the embodiment illustrated, the vehicle is operating to dig a trench, for instance, 6 metres in depth. The hydraulic adjusting apparatus 33, 34 can be adjusted to shift the bottom end of the digging bar rectilinearly upwards. The sprocket wheel 21 then moves, for instance, into the position 21', the ball and socket joints 36, 37 moving into the positions 36', 37'. On further actuation of the hydraulic adjusting apparatus 33, 34 the sprocket wheel 21 is moved, for instance, into the position 21", and the ball and socket joints 36, 37 move into the positions 36", 37". The rods 15, 17 are then in positions 15", 17". The sprocket wheel 20 is in the position 20". The result of the great length of the digging bar 19, required to dig a trench as deep as this, is that in the position in which the references have a double prime index, the digging bar is already extending a fairly large distance upwards. If the rectilinear upward movement of the bar continues, the digging bar will extend too far upwards, and the vehicle will be unable to move off

along the road. Due to the hingeable attachment of the pivot 5, the hydraulic adjusting apparatus 8, 9 can then be actuated to tilt the pivot 5 and the lifting apparatus attached thereto, together with the digging bar, in the forward direction. The whole unit then moves into the position shown in chain lines, in which the various members have the same references followed by a triple prime index.

As can be seen in fig 3, due to the vertical pivot 5 with sleeve 10 rotatable thereabout, the vehicle 1 can describe curves , so that curved trenches can also be dug. Since the digging bar 9 is moved in the vertical direction, in all its positions it occupies only a very small distance of the trench in the horizontal direction, so that the bar 9 will not be twisted as a curve is formed in the line of the trench. Due to the rods 14, 16; 15, 17 attached via ball and socket joints to the framework 18 and the transverse beams 12, 13 the vehicle can also rotate around a horizontal axis in relation to the digging bar, as shown in fig 2. The result is that if the ground becomes uneven, no great forces need be exerted on the digging mechanism. The torsion bars 31, 32 afford a limited freedom of movement, while nevertheless a reliable reaction force is produced ensuring that a completely adequate straightening effect is exerted on the digging bar. When the vehicle is travelling over flat ground, therefore, the digging bar is held vertical with adequate force, so that the trench is not deflected from the vertical by chance circumstances.

CLAIMS

1. An apparatus for digging a trench comprising a digging chain guided around sprocket wheels mounted on both ends of a digging bar, a vehicle by which the digging bar is carried, the depth of the lower end of the digging bar being adjustable by a hydraulically actuable piston-cylinder unit, and the apparatus having means for feeding from the vehicle at the level of the free end of the digging bar a flexible pipe to be laid at the bottom of the trench to be dug, the digging bar being connected to the vehicle via a hinge having an axis perpendicular to the base of the vehicle.

2. Apparatus according to claim 1, characterised in that the digging bar is supported by a lifting system which makes the lower end of the digging bar perform a substantially rectilinear lifting movement in the bar's own direction, and the means for feeding the flexible pipe are formed by a guide pipe which extends close behind the digging bar parallel therewith, is rigidly connected to the digging bar and has at its bottom end a mouth-piece directed away from the digging chain.

3. Apparatus according to claim 2, characterised in that the digging bar has at least two beams which are disposed transversely of the plane of the digging chain, are spaced out from one another in the direction of the digging bar and are each connected at their ends via rods and ball and socket joints to the ends of one of

two beams vertically spaced out from one another and attached to a sleeve which can rotate around a pivot attached to the vehicle perpendicularly to the base thereof, and at least two of the rods having ball and socket joints are rigidly interconnected via two transverse bars interconnected via at least one torsion bar rigidly attached to each of the transverse bars.

4. Apparatus according to claim 3, characterised in that the hydraulic apparatus for adjusting the digging depth is hingeably connected by one end to the rotary sleeve and is hingeably connected by the other end to one of the transverse bars.

5. Apparatus according to claims 2, 3 or 4, characterised in that the vertical pivot is attached to the vehicle via a hinge having a horizontal pivot perpendicular to the longitudinal axis of the vehicle, and a second hydraulic adjusting apparatus is hingeably connected by one end to a fixed member of the vehicle and is hingeably connected by the other end to the vertical pivot.

6. Apparatus according to claim 5, characterised in that portion of the vertical pivot with which the hydraulic adjusting apparatus engages extends through a groove extending peripherally in the bush.

7. An apparatus for digging a trench substantially as herein described with reference to the accompanying drawings.

Dated this the 23rd day of February, 1970.
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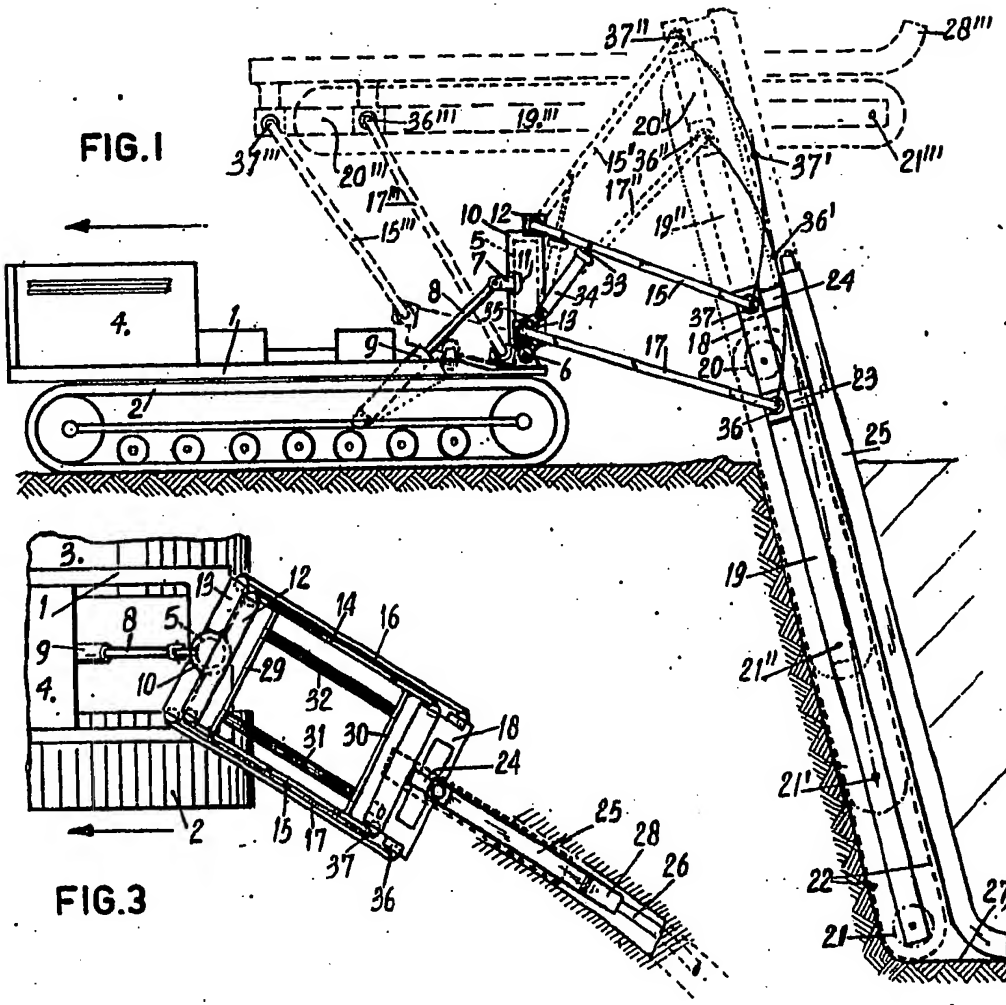

FIG.1

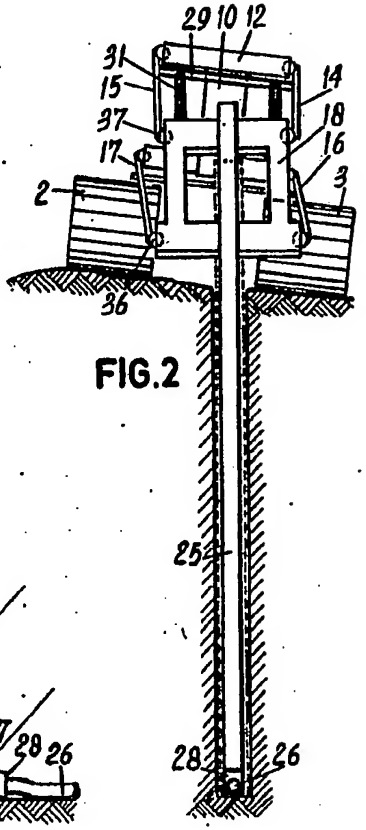

FIG.2

FIG.3